## TA2149BN,TA2149BFN

3 V AM/FM 1 Chip Tuner IC (for Digital Tuning System)

TA2149BN, TA2149BFN are AM/FM 1 chip tuner ICs, which are designed for portable Radios and 3 V Head phone Radios.

This is suitable for Digital Tuning System Applications. FM Local Oscillation Voltage is set up low relativity, for NEW FCC.

## Functions

- For NEW FCC.
- Suitable for combination with Digital Tuning System which is induded IF Counter.
- Adjustable for IF count output sensitivity by external resistance of pin 17 (FM only).
- One terminal type AM/FM IF count output for IF counter of Digital Tuning System.
- FM: 1.3375 MHz (1/8 dividing)
- AM: 450 kHz
- Built-in Mute Circuit for IF count output.
- For adopting ceramic Discriminator, it is not necessary to adjust the FM Quad Detector Circuit.
- Built-in FM MPX VCO circuit.
- Built-in one terminal type AM/FM Local Oscillator Buffer Output for Digital Tuning System Applications.
- Built-in 1/16 Pre-scaler for FM Local OSC Buffer.


Weight
SDIP24-P-300-1.78: 1.2 g (Typ.)
SSOP24-P-300-0.65A: 0.14 g (Typ.)

- Built-in AM Low cut circuit.
- Low supply current. ( $\mathrm{V} \mathrm{CC}=3 \mathrm{~V}, \mathrm{Ta}=25^{\circ} \mathrm{C}$ )

$$
\begin{aligned}
\operatorname{ICCq}(F M) & =13 \mathrm{~mA}(\text { Typ. }) \\
\operatorname{ICCq}(A M) & =8.5 \mathrm{~mA}(\text { Typ. })
\end{aligned}
$$

- Operating Supply voltage range: $\mathrm{VCC}=1.8 \sim 7 \mathrm{~V}\left(\mathrm{Ta}=25^{\circ} \mathrm{C}\right)$

Note 1: Handle with care to prevent devices from deteriorations by static electricity.

## Block Diagram



## Explanation of Terminals

(Terminal Voltage: Typical terminal voltage at no signal with test circuit, $\mathrm{V}_{\mathrm{Cc}}=3 \mathrm{~V}, \mathrm{Ta}=25^{\circ} \mathrm{C}$ )

| PIN <br> No. | Characteristic | Internal Circuit | Terminal Voltage (Typ.) (V) |  |
| :---: | :---: | :---: | :---: | :---: |
|  |  |  | AM | FM |
| 1 | RF GND (GND for FM RF stage) | - | 0 | 0 |
| 2 | FM-RFin |  | 0 | 0.8 |
| 3 | AM LOW CUT |  | 1.0 | - |
| 4 | MIX OUT |  | 3.0 | 3.0 |
| 5 | $V_{C C}$ ( $\mathrm{V}_{\mathrm{CC}}$ for AM, FM IF, MPX) | - | 3.0 | 3.0 |
| 6 | AM IF IN |  | 2.3 | 2.5 |


| $\begin{aligned} & \text { PIN } \\ & \text { No. } \end{aligned}$ | Characteristic | Internal Circuit | Terminal Voltage (Typ.) (V) |  |
| :---: | :---: | :---: | :---: | :---: |
|  |  |  | AM | FM |
| 7 | FM IF IN |  | 3.0 | 3.0 |
| 8 | GND <br> (GND for AM, FM IF, MPX) | - | 0 | 0 |
| 9 | AGC |  | 0 | 0 |
| 10 | QUAD |  | 2.5 | 2.2 |
| $\begin{aligned} & 11 \\ & 12 \end{aligned}$ | R-OUT L-OUT |  | 1.2 | 1.2 |


| $\begin{aligned} & \text { PIN } \\ & \text { No. } \end{aligned}$ | Characteristic | Internal Circuit | Terminal Voltage (Typ.) (V) |  |
| :---: | :---: | :---: | :---: | :---: |
|  |  |  | AM | FM |
| 13 | LPF2 <br> - LPF terminal for phase detector <br> - Bias terminal AM/FM SW circuit $\mathrm{V}_{13}=\mathrm{GND} \rightarrow \mathrm{AM}$ $\mathrm{V}_{13}=\mathrm{OPEN} \rightarrow \mathrm{FM}$ |  | 0 | 2.2 |
| 14 | LPF1 <br> - LPF terminal for synchronous detector <br> - VCO stop terminal $\mathrm{V}_{14}=\mathrm{GND} \rightarrow \mathrm{VCO}$ STOP |  | 0.7 | 2.4 |
| 15 | MPX IN |  | 0.7 | 0.7 |
| 16 | DET OUT | (a) LOW $\rightarrow \mathrm{FM}, \mathrm{HIGH} \rightarrow \mathrm{AM}$ <br> (b) LOW $\rightarrow \mathrm{AM}, \mathrm{HIGH} \rightarrow \mathrm{FM}$ | 1.0 | 0.9 |


| PIN |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| No. |
| Characteristic | IF REQ


| $\begin{aligned} & \text { PIN } \\ & \text { No. } \end{aligned}$ | Characteristic | Internal Circuit | Terminal Voltage (Typ.) (V) |  |
| :---: | :---: | :---: | :---: | :---: |
|  |  |  | AM | FM |
| 22 | AM RFin |  | 3.0 | 3.0 |
| 23 | $\begin{array}{\|l\|l} \mathrm{RF} \mathrm{~V}_{\mathrm{CC}} \\ \left(\mathrm{~V}_{\mathrm{CC}} \text { for } \mathrm{FM}\right. \\ \text { RF stage }) \end{array}$ | - | 3.0 | 3.0 |
| 24 | FM RFout | cf. pin 1 | 3.0 | 3.0 |

## Application Note

## 1. AM Low-Cut Circuit

- TheAM Low-Cut action is carried out by the bypass of the high frequency component of the positive-feedback signal at the AF AMP stage. The external capacitor: C3 by-pass this component.
- The cut-off frequency fL is determined by the internal resistance $22 \mathrm{k} \Omega$ (Typ.) and the external capacitor C 3 as following;

$$
\mathrm{f}_{\mathrm{L}}=\frac{1}{2 \times \pi \times 22 \times 10^{3} \times \mathrm{C}_{3}}(\mathrm{~Hz})
$$



- In the case of the AM Low-Cut function is not needed, set up the value of C3 over $1 \mu \mathrm{~F}$. In the condition of $\mathrm{C}_{3} \geqq 1 \mu \mathrm{~F}$, the frequency characteristic has flat response at the low frequency.
- It is possible to reduce the recovered output level at AM mode, by additional resistance between the pin 3 and GND line.


## 2. FM Detection Circuit

For the FM detection circuit, detection coil is able to use instead of ceramic discriminator.
Recommended circuit and recommended coil are as follows. (In this case, please take care that Vin (lim.) falls a little.)


| Test <br> Frequency | Co <br> $(\mathrm{pF})$ | Qo | Turns |  |  |  | Wire <br> $(\mathrm{mm} \phi)$ | Reference |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | $1-2$ | $2-3$ | $1-3$ | $4-6$ |  |  |  |
| 10.7 MHz |  | 45 | - | - | 30 | - | 0.08 UEW | Toko Co., Ltd. <br> 600BEAS-10018Z |

## 3. FM/AM switch and forced monaural switch.

- FM/AM switchover and stereo/forced monaural switchover are done by pin 13 and pin 14.
- FM/AM switch (pin 13)

V13: Low (Active Low, Vth $=0.2 \mathrm{~V}$ (Typ.), Ith $30 \mu \mathrm{~A}$ (Typ.) $\rightarrow \mathrm{AM}$
V13: OPEN $\rightarrow$ FM

- Stereo/forced monaural switch (pin 14)

V14: Low (Active Low, Vth $=0.2 \mathrm{~V}$ (Typ.), Ith $30 \mu \mathrm{~A}$ (Typ.) $\rightarrow$ F orced Monaural
V14: OPEN
$\rightarrow$ Stereo


## 4. Vcc Line

This ICs have two voltage supply terminals, VCC (for AM, FM IF, MPX stage) and RF Vcc (for FM RF stage). Set up the potential difference between VCC and RF VCC 0.4 V (typ.) or less, otherwise there is the case that this IC doesn't operate normally.
5. How to control the Divider of FM OSC.


Divider of FM OSC ON/OFF switching is controlled by external pull-up resistor of pin 19.
In case of Divider of FM OSC is used, it is necessary to set up the value of R under $470 \Omega$ (typ.).
When $R$ is over $470 \Omega$, it is feared that Divider is not operating. (At this time, buffer output frequency is equal to FM OSC frequency.)
Which ever Divider of FM OSC is used or not, AM OSC buffer frequency and output level is same.

| Mode | SW8 | Output Frequency | Output Level (Typ.) |
| :---: | :---: | :---: | :---: |
|  | OPEN | $1 / 1 \mathrm{FM}$ OSC | 35 mVrms |
|  | ON | $1 / 16$ FM OSC | 110 mVrms |
| AM | OPNE | $1 / 1 \mathrm{FM} \mathrm{OSC}$ | 75 mVrms |
|  | ON |  |  |

## 6. How to adjust the IF Count Output Sensitivity

IF count output sensitivity can be adjusted by changing the value of external resistance at pin 17.
This ICs have IF signal level detector in pin 9 . When DC voltage of pin 9 is high than threshold, IF count output signal come out from the pin 17.
And this threshold is controlled by value of external resistance at pin 19.


Maximum Ratings $\left(\mathbf{T a}=25^{\circ} \mathrm{C}\right)$

| Characteristics |  | Symbol | Rating | Unit |
| :---: | :---: | :---: | :---: | :---: |
| Supply voltage |  | $\mathrm{V}_{\mathrm{CC}}$ | 8 | V |
| LED current |  | ILED | 10 | mA |
| LED voltage |  | VLED | 8 | V |
| Power dissipation | TA2149BN | $\begin{aligned} & \mathrm{PD}_{\mathrm{D}} \\ & \text { (Note 2) } \end{aligned}$ | 1200 | mW |
|  | TA2149BFN |  | 500 |  |
| Operating temperature |  | Topr | -25~75 | ${ }^{\circ} \mathrm{C}$ |
| Storage temperature |  | $\mathrm{T}_{\text {stg }}$ | -55~150 | ${ }^{\circ} \mathrm{C}$ |

Note 2: Derated above $\mathrm{Ta}=25^{\circ} \mathrm{C}$ in the proportion of $9.6 \mathrm{~mW} /{ }^{\circ} \mathrm{C}$ for TA 2149 BN of $4 \mathrm{~mW} /{ }^{\circ} \mathrm{C}$ for TA2149BFN.
Electrical Characteristics (Unless otherwise specified, $\mathbf{T a}=\mathbf{2 5}{ }^{\circ} \mathrm{C}, \mathrm{V}_{\mathrm{CC}}=\mathbf{3 V}$,
F/E: $\mathrm{f}=\mathbf{9 8} \mathrm{MHz}, \mathrm{f}_{\mathrm{m}}=1 \mathrm{kHz}$
FM IF: $\mathrm{f}=\mathbf{1 0 . 7} \mathbf{~ M H z}, \Delta \mathrm{f}= \pm \mathbf{7 5} \mathrm{kHz}, \mathrm{f}_{\mathrm{m}}=\mathbf{1} \mathrm{kHz}$
AM: $\mathrm{f}=1 \mathrm{MHz}, \mathrm{MOD}=30 \%, \mathrm{f}_{\mathrm{m}}=1 \mathrm{kHz}$
MPX: $\mathrm{f}_{\mathrm{m}}=\mathbf{1} \mathrm{kHz}$ )

| Characteristic |  | Symbol | Test Circuit | Test Condition | Min | Typ. | Max | Unit |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Supply current |  | ICC (FM) | - | $V_{\text {in }}=0, F M$ mode | - | 13 | 16.5 | mA |
|  |  | ICC (AM) | - | $\mathrm{V}_{\text {in }}=0$, AM mode | - | 8.5 | 11.0 |  |
| F/E | Input limiting voltage | $\mathrm{V}_{\text {in }}(\mathrm{lim})$ | - | $\begin{aligned} & \mathrm{V}_{\text {in }}=60 \mathrm{~dB} \mu \mathrm{~V} \text { EMF, } \\ & -3 \mathrm{~dB} \text { limiting } \end{aligned}$ | - | 10 | - | $\mathrm{dB} \mu \mathrm{V}$ EMF |
|  | Local OSC buffer output voltage 1 | VOSC (buff) FM1 | - | $\mathrm{fOSC}=108.7 \mathrm{MHz}$ | 23 | 35 | - | mVrms |
|  | Local OSC buffer output voltage 2 | Vosc (buff) FM2 | - | $\begin{aligned} & \text { fosc }=6.79375 \mathrm{MHz} \\ & \text { SW8: ON } \end{aligned}$ | 75 | 110 | - | mVrms |
| FM IF | Input limiting voltage | $\mathrm{V}_{\text {in }}(\mathrm{lim}) \mathrm{IF}$ | - | $\mathrm{V}_{\text {in }}=80 \mathrm{~dB} \mu \mathrm{~V}$ EMF, <br> -3dB limiting | 37 | 42 | 47 | dB $\mu \mathrm{V}$ EMF |
|  | Recovered output voltage | $\mathrm{V}_{\mathrm{OD}}$ | - | $\mathrm{V}_{\text {in }}=80 \mathrm{~dB} \mu \mathrm{~V}$ EMF | 200 | 250 | 300 | mV rms |
|  | Signal to noise ratio | S/N | - | $\mathrm{V}_{\text {in }}=80 \mathrm{~dB} \mu \mathrm{~V}$ EMF | - | 75 | - | dB |
|  | Total harmonic distortion | THD | - | $\mathrm{V}_{\text {in }}=80 \mathrm{~dB} \mu \mathrm{~V}$ EMF | - | 0.3 | - | \% |
|  | AM rejection ration | AMR | - | $\mathrm{V}_{\text {in }}=80 \mathrm{~dB} \mu \mathrm{~V}$ EMF | - | 60 | - | dB |
|  | IF count output frequency | $\mathrm{f}_{\mathrm{IF}}$ (FM) | - | $\mathrm{V}_{\text {in }}=80 \mathrm{~dB} \mu \mathrm{~V}$ EMF, SW7: ON | 1.3373 | 1.3375 | 1.3377 | MHz |
|  | IF count output voltage | $\mathrm{V}_{\mathrm{IF}}$ (FM) | - | $\mathrm{V}_{\text {in }}=80 \mathrm{~dB} \mu \mathrm{~V}$ EMF, SW7: ON | 250 | 290 | 330 | $m V_{p-p}$ |
|  | IF count output sensitivity | IF sens (FM) | - | SW7: ON | 42 | 47 | 52 | $\mathrm{dB} \mu \mathrm{V}$ EMF |
| AM | Gain | GV | - | $\mathrm{V}_{\text {in }}=27 \mathrm{~dB} \mu \mathrm{~V}$ EMF | 20 | 38 | 70 | mVrms |
|  | Recovered output voltage | $\mathrm{V}_{\mathrm{OD}}$ | - | $\mathrm{V}_{\text {in }}=60 \mathrm{~dB} \mu \mathrm{~V}$ EMF | 60 | 85 | 108 | mV rms |
|  | Signal to noise ratio | S/N | - | $\mathrm{V}_{\text {in }}=60 \mathrm{~dB} \mu \mathrm{~V}$ EMF | - | 41 | - | dB |
|  | Total harmonic distortion | THD | - | $\mathrm{V}_{\text {in }}=60 \mathrm{~dB} \mu \mathrm{~V}$ EMF | - | 0.7 | - | \% |
|  | Local OSC buffer output voltage | Vosc (buff) AM | - | $\mathrm{fOSC}=1.45 \mathrm{MHz}$ | 55 | 75 | - | mVrms |
|  | IF count output voltage | VIF (AM) | - | $\mathrm{V}_{\text {in }}=60 \mathrm{~dB} \mu \mathrm{~V}$ EMF, SW7: ON | 250 | 290 | 350 | $m V_{p-p}$ |
|  | IF count output sensitivity | IF sens (AM) | - | SW7: ON | 33 | 38 | 43 | $\mathrm{dB} \mu \mathrm{V}$ EMF |
| Pin 17 output resistance |  | $\mathrm{R}_{17}$ | - | FM mode | - | 0.75 | - | $\mathrm{k} \Omega$ |
|  |  | - | AM mode | - | 15.5 | - |  |


| Characteristic |  |  | Symbol | Test Circuit | Test Condition |  | Min | Typ. | Max | Unit |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| MPX | Input resistance |  | $\mathrm{R}_{\text {IN }}$ | - | - |  | - | 55 | - | $\mathrm{k} \Omega$ |
|  | Output resistance |  | ROUT | - | - |  | - | 5 | - | $k \Omega$ |
|  | Max. composite signal input voltage |  | $V_{\text {in MAX }}$ (Stereo) | - | $\begin{aligned} & L+R=90 \%, P=10 \%, \\ & S W 3: L P F ~ O N \\ & f_{m}=1 \mathrm{kHz}, \mathrm{THD}=3 \% \end{aligned}$ |  | - | 700 | - | mVrms |
|  | Separation |  | Sep. |  | $L+R=$ 180 mVrms , $\mathrm{P}=20 \mathrm{mVrms}$ SW3: LPF ON | $\mathrm{f}_{\mathrm{m}}=100 \mathrm{~Hz}$ | - | 45 | - | dB |
|  |  |  | - | $\mathrm{f}_{\mathrm{m}}=1 \mathrm{kHz}$ |  | 35 | 45 | - |  |
|  |  |  |  | $\mathrm{f}_{\mathrm{m}}=10 \mathrm{kHz}$ |  | - | 45 | - |  |
|  | Total harmonic distortion | Monaural |  | THD <br> (Monaural) | - | $\mathrm{V}_{\mathrm{in}}=200 \mathrm{mVrms}$ |  | - | 0.3 | - | \% |
|  |  | Stereo |  | THD (Stereo) | - | $\mathrm{L}+\mathrm{R}=180 \mathrm{mVrms}$, P = 20 mVrms , SW3: LPF ON |  | - | 0.3 | - |  |
|  | Voltage gain |  | GV | - | $\mathrm{V}_{\text {in }}=200 \mathrm{mVrms}$ |  | -2.7 | -1.2 | 0.2 | dB |  |
|  | Channel balance |  | C.B. | - | $\mathrm{V}_{\text {in }}=200 \mathrm{mVrms}$ |  | -1.5 | 0 | 1.5 | dB |  |
|  | Stereo LED sensitivity | ON | $\mathrm{V}_{\mathrm{L}}$ (ON) | - | Pilot input (19 kHz) |  | - | 10 | 14 | mVrms |  |
|  |  | OFF | $\mathrm{V}_{\mathrm{L}}$ (OFF) | - |  |  | 5 | 8 | - |  |  |
|  | Stereo LED hysteresis |  | $\mathrm{V}_{\mathrm{H}}$ | - | To LED turn off from LED turn on |  | - | 2 | - | mVrms |  |
|  | Capture range |  | C.R. | - | $\mathrm{P}=15 \mathrm{mVrms}$ |  | - | $\pm 8$ | - | \% |  |
|  | Signal noise ratio |  | S/N | - | $\mathrm{V}_{\text {in }}=200 \mathrm{mVrms}$ |  | - | 80 | - | dB |  |
| Muting attenuation |  |  | MUTE | - | $\mathrm{V}_{\text {in }}=200 \mathrm{mVrms}$ |  | - | 80 | - | dB |  |

Coil Data

| Coil No. | Test Freq. | $\begin{gathered} \mathrm{L} \\ (\mu \mathrm{H}) \end{gathered}$ | $\begin{gathered} \mathrm{Co} \\ (\mathrm{pF}) \end{gathered}$ | Qo | Turns |  |  |  |  | Wire (mm $\phi$ ) | Reference |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  | 1-2 | 2-3 | 1-3 | 1-4 | 4-6 |  |  |
| L 1 FM RF | 100 MHz | - | - | 79 | - | - | $2 \frac{1}{2}$ | - | - | 0.16UEW | Toko Co., Ltd. 666SNF-305NK |
| $\mathrm{L}_{2}$ FM OSC | 100 MHz | - | - | 76 | - | - | 2 | - | - | 0.16UEW | Toko Co., Ltd. 666SNF-306NK |
| T ${ }_{1}$ AM OSC | 796 kH z | 268 | - | 65 | 19 | 95 | - | - | - | 0.05UEW | Toko Co., Ltd. 5PNR-5146Y |
| T2 AM IFT | 455 kH z | - | 470 | 60 | - | - | 109 | - | 7 | 0.05UEW | Toko Co., Ltd. 5PLG-5147X |

$\mathrm{L}_{1}$ : FM RF

$\mathrm{L}_{2}$ : FM OSC
(1) ${ }^{3}$
$T_{1}$ : AM OSC

$\mathrm{T}_{2}$ : AM IFT


## Test Circuit



## Package Dimensions

Unit : mm


Weight: 1.2 g (typ.)

## Package Dimensions



Weight: 0.14 g (typ.)

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